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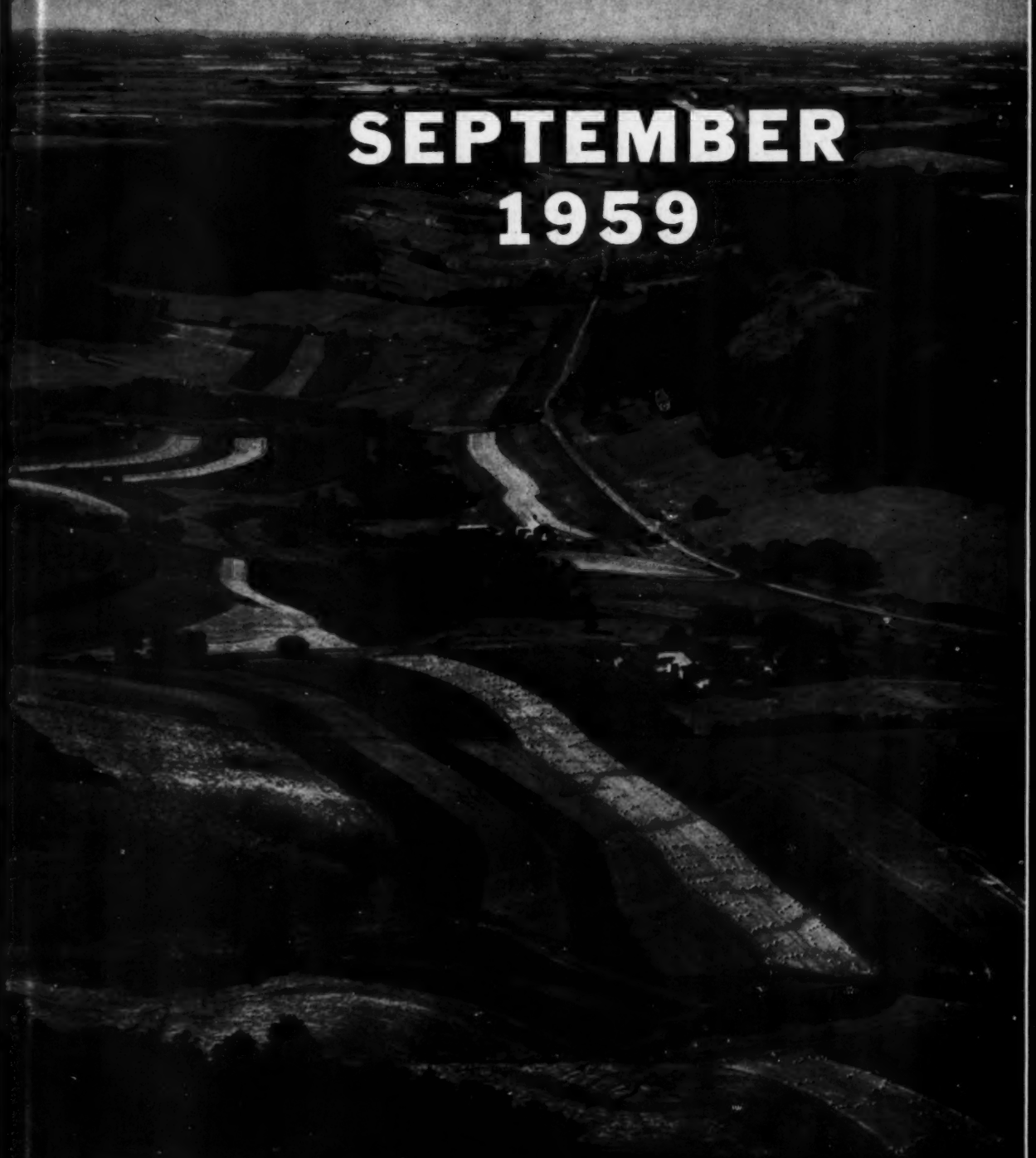

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DONALD A. WILLIAMS
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★ THIS MONTH ★

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TOM DALE, Editor

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THE INDUS VALLEY.—One of Man's earliest civilizations arose in the Indus Valley. Like the contemporary civilizations in the Nile and Euphrates Valleys, it was based on irrigation agriculture. The perennial flow and semiannual floods of the Indus River supplied the irrigation water that enabled men to build cities, become civilized, and prosper for more than 15 centuries in this arid environment.

As the foothills of the Hindu Kush and Himalaya Mountains were deforested, floods and siltation increased and both flood and irrigation problems became acute. Archaeological findings indicate that some of the ancient cities were temporarily abandoned on account of floods at least twice before their final downfall.

The extinction of this early Indus civilization came about 1700 B.C., apparently as a result of conquest by the barbarous Aryans who sacked the weakened cities and brought on a "dark age." A new civilization arose in the lower Indus Valley a few centuries later, and through all the vagaries of wars and conquests survived until about A. D. 1200.

In the meantime, the Indus River became increasingly hard to control. The silt carried by the river built its bed and alluvial plains higher and higher; floods became more frequent and drastic; the course of the river shifted frequently.

(Continued on page 35)

FRONT COVER.—Pleasant Valley, Minnesota, as seen from the air.

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Reseeding Depleted Range

By EARL SPENDLOVE

THE Heaton brothers, Vard, Lloyd, Gail, and Ross, had real feed troubles before they started seeding their worn out range and managing it better—steps that reaped some eye-opening and money-making gains.

Take the spring of 1953, one of the driest in southern Utah annals. That season, the brothers grazed 900 sheep for about 2 weeks on 200 acres of new grass. A few years back the same land "wouldn't turn out a lick of feed."

Since then range forage has been getting better and better. Calves born in the spring average 370 pounds when they go on winter range in October. Lambs born after May 15 average 80 pounds, 20 pounds more than 20 years ago. This year the lamb crop ran 125 percent, the calf crop 98 percent.

Note:—The author is work unit conservationist, Soil Conservation Service, Nephi, Utah.

For their range building, the Heatons were presented the 1958 Top Rancher of the Year award by the School of Forestry of Utah State University.

The Heatons maintain a breeding herd of 150 cows and 2,500 ewes and each fall purchase steer calves to be wintered with their breeding herd on public and private lands on the "Arizona strip", that portion of Arizona lying between the Colorado River and the Utah State line. The number of calves purchased depends upon the feed on the winter range at the end of the growing season. All calves except those kept to maintain the breeding herd are sold in the spring. Lambs are sold in the fall.

The breeding herd, together with spring-born lambs and calves, spend about 2 months on the Heatons' privately owned range in the spring and about a month again in the fall. During summers they graze National forest land.

A part of the Heaton ranch that was converted from sagebrush to good grass by reseeding.

Early settlers in this area often turned out too many stock too early in the spring. Before they realized it, many of the native grasses and good browse disappeared. In their place came sage and rabbit brush, juniper, and pinon. Topsoil eroded from slopes and gullies moved in and drained the meadowland along creeks.

A good many ranchers face this problem of getting grazed off areas back into production. The dire need for feed spurred the Heatons on.

Vard Heaton explains things this way: "One of the first moves we made was to reduce our per acre stocking rate by buying more land. Next we filled up gullies at the bottom of drainages, dammed 'em up to hold back silt. Then we went after our scanty spring-fall range. We scattered seed among the sagebrush and oak from horseback as we worked the stock. This seeding failed because we didn't cover the seed and because it had to compete with the brush for moisture and plant food. That ended our plantings for some time."

In the next few years the brothers worked out a conservation plan with the Kane County Soil Conservation District. Among other things, the plan called for clearing land before seeding, plus no grazing until the grass was well along.

In the fall of 1949, the Heatons tried again. They picked a fenced area south of Alton, where the elevation is about 7,000 feet and the rainfall about 17 inches. Here the heavy clay soil produced a thick stand of pinon and juniper with little vegetation under the trees—real tough going for range grasses.

Brush and trees were bulldozed into windrows. Part of the land was plowed and a mixture of smooth brome and crested and western wheatgrasses broadcast and harrowed in. On the rest of the land, seed was drilled directly into the soil after trees were pushed off.

To use spring and winter moisture, which is usually dependable in this area, the seeding was done in the fall so seed would be in the ground and ready to grow as soon as the weather warmed up in the spring.

Next summer, a thick stand of weeds covered the seeded area and the Heatons figured they had failed again. On closer examination, they found a lot of grass growing in the weeds. And there was more grass in plowed than unplowed areas. This good seeding started the Heatons off on a year-to-year seeding program. Each year since then, 50 to 100 acres have been cleared and seeded, a total of about 1,000 acres to date. On many of these seedings, the Heatons

On left of fence is part of Heaton ranch that was reseeded to improve grasses. At right is range that has been protected from grazing but not seeded.

have received financial assistance from the Agricultural Conservation Program.

Drilling is the rule now and they have given up the complicated mixtures they first tried because the stock grubbed species like intermediate wheatgrass and smooth brome into the ground before they made any use of species such as tall, crested, or western wheatgrass. More recent plantings have consisted of smooth brome or intermediate wheatgrass with a legume such as alfalfa or sweet clover. Planting a single species or planting species of similar palatability have eliminated a lot of the waste they had with their early mixtures.

Looking back on these seedings Vard says, "Making a set of seeding rules to fit every rancher's needs is like a dressmaker trying to make a dress to fit every woman's taste and pocketbook. Here are some ground rules we've found helpful:

"Before seeding make up your mind to give the area total protection until grasses are well established. This can be done by herding or fencing. In our case we found fencing to be best. We try to locate fences so that they will help us manage our range and work out grazing rotations after the seeding is ready for stock.

"Young grass plants are really tender and delicate and can't stand grazing the first year. We graze most of our plantings in the fall, after the second summer. We wait a third year if grass growth is slow.

"Getting the seedbed in good shape is a must. It depends largely on the soil and the ground cover. Land that has been farmed can be handled just as you would for planting small grain. Keep the land free of weeds during the summer, but give the soil a chance to firm up well before fall planting.

"We didn't have much luck seeding land that had been farmed for years. We think this was because crops had taken considerable fertility and soil moisture. Summer fallowing might help get a better stand on this land.

"We use a bulldozer or chain to kill brush and trees. Sometimes it takes a couple of times to do the job. We always plow the land after it is cleared to make sure we have got rid of all competition. Then, whenever possible, we use a drill to plant grass. It spreads seed evenly

SCS technician with Gail and Ross Heaton clip grass on reseeded range to show that it produces more than 5 times as much usable forage as unseeded range.

over the ground, covers it and gives a better stand of grass per pound of seed. Ground that is too rough or littered to drill is broadcast and covered with a harrow or brush drag.

"Be sure and plant more grass—not more weeds. The best bet is certified seed.

"You just can't hit on a grass to fit all conditions. I like Herefords for range cattle. Yet I know of places where Brahma and Brahma-Hereford crosses will do well where Herefords would starve to death. It's the same with grasses," Vard said.

"Our stock go for brome and intermediate and stiffhair wheatgrasses better than for tall and crested wheatgrass," Lloyd Heaton broke in, "but we have some alkali spots on our range where nothing will grow but tall wheatgrass and sweet clover."

To keep from killing out the better grasses, the Heatons use them as key species, and stop grazing a pasture when about half the forage is used up.

Until the spring of 1953, clover in the mixture was no problem. By the time sheep moved onto it, clover was mature enough so that there was no bloating. But a cold, dry spring held the clover back until it was just starting when sheep moved in. There were some bloating losses. In spite of these losses clover is liked because it produces a lot of feed and grasses seem to do better when grown with it.

Bloat is being whipped by using less clover in present plantings and delaying grazing until the clover is mature.

The Heatons have also found a way of stepping up production of native range plants. They do it by selecting plants that produce the most and best feed, then managing ranges to favor these plants.

On steep, rough mountain ranges, browse is vigorous and healthy and more native grass is showing up each year. On the Arizona ranges, better grasses are definitely on the increase. The difference in their and adjacent ranges shows up for miles along the fence line.

One of the brothers' new projects is a seed increase plot undertaken in cooperation with the Kane County SCD. Amur strain of intermediate wheatgrass seed seems to do better than most other grasses in the area. They'll use Amur in future plantings.

Not long ago Gail Heaton remarked: "It's hard to say how much we have received in dollars and cents from our range seedings. They cost us from $8 to $30 per acre. We do know that the plantings increased carrying capacity of sagebrush land from nearly nothing to 1½ cow months per acre. They gave us a dependable early spring feed when most needed. And we are using land that we merely trailed through before.

"The story is told too in the clippings my brother Lloyd and a Soil Conservation Service technician made on seeded and native ranges. They found that a seeded range, just after seed maturity the second year after planting, was producing 2,250 pounds of grass and clover per acre.

"Just over the fence on identical soil, native range was turning out less than 500 pounds of sagebrush per acre."

The Heatons have carried out more range seeding than anyone in Kane County. Still they'll tell you they have only made a good start in turning brushland into good grass.

Ross voices the feeling of all the brothers. "We have spent a lot of time seeding our ranges. We think seeding pays and we'll keep on planting good grass and legume mixtures until someone shows us something better."

PLANNING MAXIMUM INCOME IN SOIL CONSERVATION

By RUDOLPH A. CHRISTIANSEN AND JOHN R. SCHMIDT

No. 49

This is the forty-ninth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

THE level of farm income plays an important role in adoption of soil conservation practices. Farmers with a relatively low income tend to discount long-run income benefits. This kind of economic behavior may conflict with adoption of a soil conservation system of farming, particularly when it requires major changes in both the cropping and livestock programs. In addition, farmers at a low-income level tend to be more sensitive to changes in income or to the anticipation of such changes. As a result, they may choose practices that result in immediate higher income whether they be soil-conserving or not.

Relatively high-income farmers, however, can wait longer for increased income from conservation farming; therefore, they may be more receptive to adoption of recommended soil conservation practices.

As the level of income plays an important role in decisions farmers make, efforts should be made to minimize any "income drop" following adoption of a soil conservation system of farming. In doing this, the first requisite is to consider the available farm resources within the framework of an overall farm plan.

Note:—The authors are agricultural economist, Agricultural Research Service, and agricultural economist, Department of Agriculture Economics, University of Wisconsin, Madison, Wis.

The soil conservation program then becomes an integral part of such a plan. In this way, its implications on the farm business as a whole are taken into consideration. In addition, both conservation and nonconservation practices are considered in terms of their effect on income and capital requirements.

When income and capital are limited, there is economic pressure to allot resources to practices from which immediate monetary benefits can be obtained, even though soil depletion may be accelerated. In effective overall planning, careful consideration should be given to alternatives, and practices, timed to provide a favorable flow of income without eliminating the soil conservation goals.

Knowledge in the hands of farmers and farm planning technicians regarding the future or potential income of an individual farm, therefore, is most helpful for making favorable soil conservation decisions. This knowledge should be related to the particular soil type in question. Usually, such knowledge is general in nature; it must be used with sound judgement when applied to individual situations.

Preliminary results from research now conducted by the Farm Economics Research Division, Agricultural Research Service, and the Wisconsin Agricultural Experiment Station reveal that net farm income associated with specific dominant soil types can be increased materially by improving both cropping and livestock practices.

In this study, the farm business records for 195 farms were analyzed. All of the farmers involved were members of the Northwest Wisconsin Farm Management Association. The dominant soil types found on the individual farms were used as a basis for classification. In this way, the inherent differences in each type are reflected in the net income results. There were 12 dominant soil types on the 195 farms.

The average yields for the principal crops grown on the sample farms in 1953, 1954, and 1955 were summarized for the 12 soil types. In addition, the past rotations were determined from the distribution of the cropland as reflected by the crop history in the 3-year period.

For comparative purposes, recommended rotations were developed and expected yields estimated under the recommended levels of soil and crop management. The recommended rotations were based on available knowledge of the designated soil types including degree of soil loss, slope length and gradient, and available land use capability indexes. It was ascertained that the recommended rotations would provide the greatest return to the farm without precluding adequate conservation of available soil re-

Rotations and yields on 12 dominant soil types under past and recommended levels of crop and soil management

Soil type	Past		Recommended	
	Crop rotation	Yield per acre	Crop rotation	Yield per acre
Santiago-Otterholt	C	65.4	C	85.0
	O	50.2	O	70.0
	HH	2.6	HH	3.5
Spencer	C	61.1	CC	80.0
	O	48.8	O	65.0
	H	2.8	HH	3.5
Waukegan	CC	67.3	CCC	90.0
	O	53.4	O	70.0
	H	2.9	H	3.5
Antigo	CC	59.0	CCC	85.0
	O	46.2	O	70.0
	HH	2.5	H	3.0
Jackson	CC	69.9	CC	105.0
	O	51.1	O	65.0
	H	3.2	H	4.0
Dakota	C	59.2	CCC	70.0
	O	51.1	O	55.0
	H	2.1	H	3.0
Onamia	C	52.1	CC	70.0
	O	54.6	O	65.0
	H	2.0	H	2.5
Jewett	CC	64.4	CC	95.0
	O	51.4	O	70.0
	H	2.5	H	4.0
Hines	C	57.9	C	90.0
	O	46.3	O	65.0
	H	2.5	HH	3.7
Fayette	CC	63.7	C	100.0
	O	44.9	O	70.0
	HH	2.6	HH	4.0
Gale	C	59.7	C	75.0
	O	49.7	O	55.0
	HHH	2.3	HH	3.0
Milaca-Freeon	C	59.0	C	70.0
	O	41.3	O	70.0
	HH	2.2	HH	3.0

sources. The recommended rotations are based on the assumption that adequate soil conservation practices would be in effect on the 12 soil types involved.

The preceding table reflects the crop rotations and yields by dominant soil type under past and recommended levels of soil and crop management. It will be noted that corn has been increased in the rotation for some of the soils. This is permitted by reducing the threat of soil loss under the recommended soil and crop practices.

The projected average yields per acre are reasonable expectations that would result from adoption of the recommended soil and crop practices including compliance with up-to-date fertilizer recommendations, acceptance of needed soil conservation practices, and other modern cultural requirements.

Based on average yields per acre and percentage of land allotted to each crop as reflected by the rotations, total yields were obtained under both past and recommended levels of soil and crop management. In order to eliminate variations because of the different farm sizes associated with each soil type, a "typical" farm size was established based on census data and other available facts related to the sample area. Farm size was set at 185 acres; however, the amount of cropland was varied to meet the conditions of the different soil types. Thus, in all instances, total farm size was constant, although land use within the typical farm was subject to variation depending on the use associated with the dominant soil types.

The crop production data obtained for specific soil types provides a base from which net income can be determined under different livestock situations. A number of different budgets were developed for varying levels of livestock management. Dairying and hog production provide the main source of income in the sample area. Budgets were developed for "7,000-lb. cows" (average annual milk production) and "average hogs," "9,000-lb. cows" and "average hogs," and "11,000-lb. cows" and "good hogs." The optimum livestock organization was budgeted for each type under both past and recommended cropping practices. A farm poultry flock of 200 hens was included in each budget.

The livestock situation involving 9,000-lb. dairy cows and average hogs approximates the existing situation in the sample area. The following table indicates that substantial increases in net income can be obtained on all soil types by improving crop practices and adjusting livestock numbers to fit the change in crop production. Although there is considerable variation between the different soil types, the differences in income are highly significant. The income drop often associated with the initial adoption of some soil conservation practices does not result in this area of Wisconsin when

Optimum net farm income expected with different levels of livestock management under past and recommended crop and soil management practices.

Soil Type	9,000-lb. cows and average hogs			11,000-lb. cows and good hogs		
	Net farm income (past)	Net farm income (recommended)	Recommended over (past)	Net farm income (past)	Net farm income (recommended)	Recommended over (past)
Santiago-Otterholt	$ 7,263	$ 9,588	$2,325	$ 9,136	$11,064	$1,928
Spencer	6,999	10,031	3,032	8,777	11,220	2,443
Waukegan	10,269	12,904	2,635	11,931	14,044	2,113
Antigo	7,931	11,898	3,967	9,860	13,169	3,309
Jackson	10,079	13,221	3,142	11,760	14,884	3,124
Dakota	7,522	8,692	1,170	9,114	10,071	957
Onamia	5,915	8,414	2,499	7,279	9,617	2,338
Jewett	7,896	12,502	4,606	9,270	13,506	4,236
Hines	7,554	10,013	2,459	9,465	11,420	1,955
Fayette	6,736	9,876	3,140	8,387	11,304	2,917
Gale	6,656	7,311	655	8,534	9,147	613
Milaca-Freeon	6,077	7,367	1,290	7,949	9,291	1,342

the livestock adjustment is made. Instead, the anticipated improvement in income provides a potent economic incentive for the adoption of recommended cropping practices and other desirable conservation measures.

Significant income improvements from adoption of recommended cropping practices would be anticipated as well with 11,000-lb. dairy cows and good hogs as shown by the preceding table.

Further comparisons can be made from the data in these tables. For example, if we compare the past income with 9,000 lb. cows and average hogs with the estimated income with 11,000 lb. cows and good hogs, the income differences are still more startling. In this instance we go from the actual situation to a high-management level including both improved livestock and recommended soil and crop management.

The authors wish to reemphasize the usefulness to farmers and farm planning technicians of reliable information concerning the income benefits that can be derived by shifting to recommended levels of crop management. In addition, information regarding the most profitable change in livestock numbers resulting from shifts to recommended cropping practices is needed to guide alternative enterprise selection and/or the expansion or contraction of existing enterprises. This kind of information should be furnished by types-of-farming areas based on dominant soil types.

Budgeted data of the kind discussed here are helpful as a guide when considered within the framework of the overall farm plan, a plan that includes both soil conservation and nonconservation practices. Only in this way is it possible to appraise with accuracy the income effect of good soil conservation practices and thereby hasten their adoption.

CONSERVATION FOR BETTER LIVING. — Unless conservation makes for better living on the land—in the rural communities—larger opportunities for farm and ranch families and greater satisfaction with country life—the purpose of conservation is unlikely to be achieved.

ERVIN L. PETERSON
Assistant Secretary of Agriculture

ONE WAY TO IMPROVE STREAM FISHING

By R. D. ANDERSON, ELLIS SEDGLEY, and CLARANCE RUEHLE

EVERY fisherman likes action when he hangs a trout and R. E. Barbour is no exception. And when he takes his catch home, he doesn't like to feel apologetic for junior-size rainbows and cutthroats.

Barbour was having the usual luck one day a number of years ago while fishing Marvine Creek on his 628 acre ranch in Rio Blanco County, Colo. He was getting a few, but they were disappointingly small. Then Barbour had an idea. It set him to wondering.

Barbour calls his place the Marvine Ranch. The creek that crosses it averages 15 to 20 feet wide and about a foot deep except during snowmelt. Then it is a little wider and much deeper. The stream for most of its length is rapid and shallow. Parts that cross the ranch, however, are somewhat deeper. The snow-fed creek is always cold and sparkling clear.

The fish that Barbour was catching that day were seldom longer than 9 inches, never as long

Note:—The authors are respectively, soil conservationist, Denver, Colo., work unit conservationist, Meeker, Colo., and engineering aid, Meeker, Colo., all of the Soil Conservation Service.

Three rock dams constructed by Barbour on Marvine Creek.

Riprapping to protect banks on Marvine Creek.

as 12. The clear shallow water made them hard to catch.

Frequent stocking, Barbour knew, was one way to improve fishing; but, it was a never-ending process. It would never mean larger, more challenging fish, the kind Barbour liked to catch.

The more Barbour turned his idea over in his mind, the sounder it seemed. He figured that the best way to make fishing better was to create better conditions for the fish to reproduce, live, and grow. It might be expensive, but Barbour pointed out to himself that it would be a once-over job and in the long run might actually cost less than piecemeal efforts. Certainly—and this was the clincher—it would make fishing in the stream a far more satisfying sport.

There were several things Barbour decided he ought to do. He would need to slow down the current and make more deep water. He would have to improve shelter and food for the fish. He would need to cut down on siltation by protecting the stream banks and make nearly all portions of the improved area easier to get to.

To slow down the stream, Barbour set out to make it meander as much as possible. He used a bulldozer and a dragline to build low rock and gravel dams. These were located at spots which forced the stream back into former ox-bows. In doing this, he added about ¼ mile to the 1½ miles of stream he formerly had.

In deepening parts of the stream Barbour used a bulldozer and dragline to make loose rock dams. These dams contain boulders from the size of a football on up. He tried to avoid piling

Meandering channel of Marvine Creek after Barbour improved it for better trout fishing.

The large rock in foreground provides shade and hiding place for trout. Anchored logs under foot-bridge also furnish shade and hiding places for fish.

up dirt and gravel. The rock dams, Barbour explained, have two advantages; they hold their own against the swift current and part of the water goes through and part over. Thus, there is little silting and clogging either above or below the dams.

Barbour also rolled large boulders into the stream to make cover and still water spots. In addition he anchored logs in some spots for more shade and still water. Trout can't swim against a current all day, Barbour explains. They need rest.

Where Barbour thought it was needed, he used riprapping to protect the banks. He spanned the stream with several small bridges, about 20 feet long, so that the creek could be fished readily from either side.

Barbour is well pleased with his work. The mile and three quarters stream length now has approximately 20 rock dams with holes ranging from 2 to 6 feet in depth. The large holes behind the dams and the rest pools offer far more favorable conditions for trout and trout food.

The stream portion on the Marvine Ranch has approximately three times as much water as unimproved sections, Barbour estimates.

And as for fish—well, Barbour and his invited friends now catch hustlers that run from 12 to 18 inches long and weigh from 1 to 2 pounds.

This is without stocking except for the dozen or so big ones, 2 to 4 pounds, that Barbour transferred from the lake on his ranch.

Barbour is confident that many a stretch of mountain stream can be helped this way. When the water is lowest in late summer it is easy to use a bulldozer or dragline. The machinery can go right up to streambed, picking up the scattered boulders and moving them into position.

Mr. Barbour has been a cooperator with the Upper White River Soil Conservation District since 1951. He has a basic plan on his Marvine Ranch and with assistance of the Soil Conservation Service technicians assigned to this district he has completed most of the conservation practices included in the plan. In addition to the stream improvement work he has leveled hay meadows, revised his irrigation system, used commercial fertilizers on his mountain meadows, and practiced good grass management.

THE INDUS VALLEY

Continued from page [26])

Finally the inhabitants gave up the fight to control the river and use its water to irrigate the arid plains.

The ancient history of the Indus Valley became veiled in obscurity, and modern historians and archaeologists did not suspect the existence of the earliest Indus civilization until 1922, when they began unearthing the ruins of the ancient cities.

Today, most of the lower Indus Valley is relatively barren. Few people have lived on the sun-baked mud flats and shifting sand dunes in modern times. Some of the foundations of the ancient cities are now below the ground-water level. The river channel is at least 20 feet higher than it was 3,000 years ago, and overflows onto the nearby alluvial plains, which are lower than the river bed, during every flood period.

The climate in the Indus Valley is apparently the same as in ancient times, but the land is not the same.

Efforts are being made to reclaim this area, irrigate it, and restore it to something like its former productivity. This should be possible because there is still plenty of soil in the valley, even though most of it is erosion debris from the highlands. Nevertheless, reclamation measures, if they are to be permanent, must start at the headwaters where the floods and silt loads originate.

Topsoil and Civilization
DALE AND CARTER

Hydrology In Soil and Water Conservation

By R. G. ANDREWS

This is the sixth and seventh of a series of articles that attempt to explain, in nontechnical terms, the duties, responsibilities, and methods of Service hydrologists.

How a Hydrologist Helps in the Design of Floodwater Retarding Structures

FLOODS may be controlled at specific locations on a river system by levees, channel enlargement and straightening, large reservoirs, or any combination of the methods. Levees control floods by providing a safe spillway for a large shallow retarding reservoir upstream from the beginning of the levee system. Channel straightening and other measures control floods by increasing the speed of travel and the volume of water past a specific location. This method may create a flood hazard downstream from the end of the channel improvement work. Large reservoirs control floods by impounding water on one area of land to control the flooding of a presumably more valuable area downstream.

Floods may be prevented by reducing the volume and delaying surface runoff from the watersheds of rivers. The volume of surface runoff is reduced by land use practices that increase the rate at which precipitation will flow into the ground-water reservoir. Surface runoff is delayed primarily by floodwater-retarding structures high on the headwater streams.

Note:—The author is head, central technical unit, Soil Conservation Service, Beltsville, Md.

Design problems of a floodwater retarding structure are unique in many respects. The structure must temporarily impound sufficient floodwater to reduce floodwater and sediment damage downstream, and it must be economically justified by those reductions; it must perform its design function automatically and be reasonably free of maintenance; it must be free from failure hazard, and quite often provide conservation storage for municipal, domestic, or irrigation water.

The hydraulic design of such a structure requires considerable professional skill and foresight. A watershed planning party hydrologist must determine the average annual area flooded by storms that have occurred in the past, and the area that would have been flooded if the structure had been in place to store a specific volume of flood runoff. From these figures and the cost of the structure, the economic justification of the structure is determined.

The hydrologist must properly proportion the detention storage and automatic release rate so that the emergency spillway is not subjected to destructive erosion. On the other hand, the release rate must not be so great that a large number of structures releasing water simultaneously will cause prolonged flooding or swamping of areas adjacent to larger river channels. The relationship between the detention storage, the maximum storage to the top of the dam (surcharge storage), and the capacity of the emergency spillway must be such that runoff from the largest storm that can reasonably be expected in the area will not cause failure of the structure. These pieces must be fitted together like the pieces of a jigsaw puzzle to produce the most effective floodwater-retarding structure for the least amount of money, at the site location where it will produce the most benefits—a challenge that will tax the ingenuity of most engineers.

If the storage of municipal, domestic, or irrigation water becomes an additional function of the floodwater-retarding structure, the problems that must be solved by the hydrologist increase in number and complexity. He must determine the average volume of water that can be expected to appear monthly at the proposed point of impoundment. The losses to evaporation through transpiration, by water-loving plants and by seepage, must be evaluated and added to the water needed for beneficial use. The amount of water supplied by rainfall that will reduce the irrigation need must be computed. Finally, a water budget analysis similar to the financial statement of a bank or other business must be prepared to determine if there will be a surplus or deficit of water. If a deficit occurs, the percent of time that water will not be available for beneficial use must be computed.

The hydrologic design of a floodwater-retarding structure involves the consideration of all the problems that would be encountered in the design of a large reservoir. However, much data on streamflow and storm patterns available to the designers of large reservoirs must be computed indirectly by the hydrologist for a floodwater-retarding structure from a knowledge of meteorology, geology, soils, and other allied sciences.

How to Evaluate an Engineer's Capabilities as a Hydrologist

HYDROLOGY is not an exact science in the same sense that meteorology is not an exact science. Positive, unqualified answers to problems are seldom, if ever, possible. It is truly a mixture of science and art—the art of combining scientific facts, observations, and experiences in the proper proportions to produce a well-balanced project.

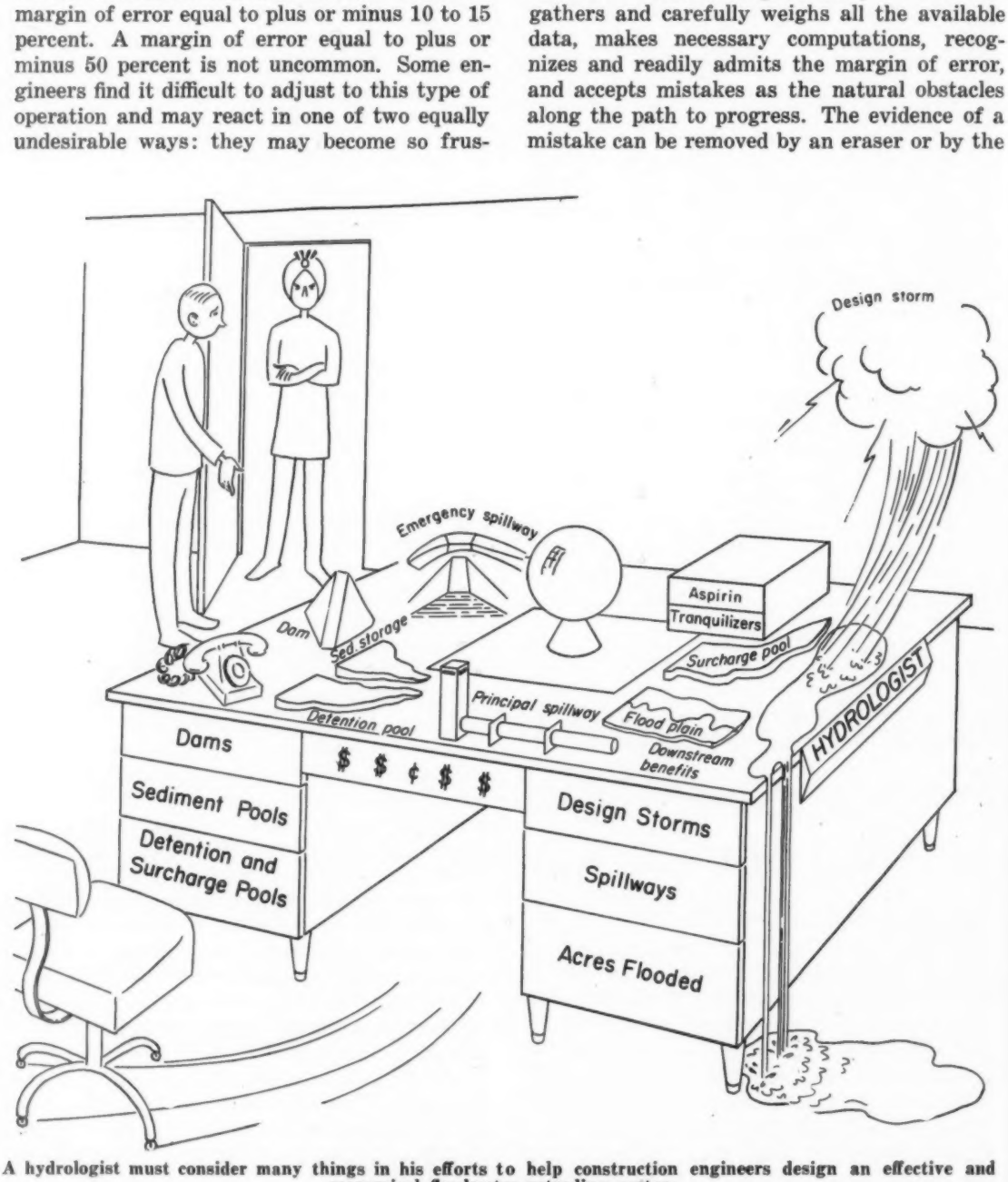
Despite the rapid advances that have been made in hydrology since 1945, there are very few oportunities for an engineer to obtain formal academic training in the science. Hydrologists must usually be trained on the job. The selection of an engineer for training in hydrology should be based upon the careful consideration of the special talents and personality traits required for the job.

Graduate engineers have been trained in the fundamentals of mathematics. However, due to deficiencies in many college curriculums, proficiency in applied mathematics must be developed by continued application and study. Statistical mathematics and analysis so important to the hydrologist are virtually nonexistent in engineering curriculums. Prospective hydrologists should have demonstrated a genuine interest in mathematics and analytical procedures. However, an overdependence on mathematics equations, especially statistical mathematical, to the extent that natural laws and limitations are not recognized, can be more detrimental than a lack of mathematical proficiency.

High on the list of desirable characteristics is intellectual curiosity—the constant seeking for the why of observed phenomena. Without intellectual curiosity the evolutionary progress that leads to improved methods and procedures is likely to be lacking, and the interrelationship of the varied allied sciences is never discovered. One who has developed a keen sense of observation and possesses the curiosity to compare and analyze that which is observed will add immeasurably to his store of knowledge.

A bachelor of science or bachelor of arts degree from a college or university certifies only that a man has completed certain educational requirements. A man who is inflexible, afraid to try new ideas, refuses to admit and thereby profit by his mistakes, or who cannot discuss impersonally proposed changes in procedures will not function harmoniously in a watershed planning party regardless of his educational background. A reluctance to accept arbitrary decisions, hastily assembled and poorly analyzed data, and crude estimates for other than reconnaissance reports is a sign of intelligence. Engineers selected for hydrologist training positions should have demonstrated the intellectual flexibility necessary to select analytical procedures commensurate with the degree of accuracy required for the completed project.

Engineers are taught that the greatest sin is inaccuracy. Measurements and computations are habitually made with considerable exactitude. Hydrologic computations when based upon the most accurate data available will contain a margin of error equal to plus or minus 10 to 15 percent. A margin of error equal to plus or minus 50 percent is not uncommon. Some engineers find it difficult to adjust to this type of operation and may react in one of two equally undesirable ways: they may become so frustrated in trying to reduce the inherent margin of error that little is accomplished, or they may conclude that an acceptable degree of accuracy is unattainable and become satisfied with crude estimates. The ideal personality is one that gathers and carefully weighs all the available data, makes necessary computations, recognizes and readily admits the margin of error, and accepts mistakes as the natural obstacles along the path to progress. The evidence of a mistake can be removed by an eraser or by the



A hydrologist must consider many things in his efforts to help construction engineers design an effective and economical floodwater retarding system.

more costly process of reconstruction, but once made it can never be eliminated and should be used advantageously.

A Service hydrologist is in the unique position of having to work with the most intimate details of flood prevention hydrology, yet he must never lose sight of overall flood prevention problems. He must have sufficient scope of vision to recognize the effect the recommended flood prevention program will have on a tributary stream, and the effect that the application of the program to many tributary streams will have on the regimen of the rivers. He must be able to visualize the physical and social impact of a flood prevention program as it affects a tributary subwatershed, tributary watershed, river basin, or State to properly advise the administrative personnel on the hydrologic aspects of the program.

Hydrology is a dynamic science with many relationships remaining to be discovered. The progress of small watershed hydrology in the next decade will be determined largely by the intelligence of the young engineers now being assigned to planning parties as hydrologists-in-training.

Drain Tile—How Are They Working?

By ROY E. TUTTLE

HOW effectively and how long do the buried tile pick up and move out the excess water? Many a farmer has looked and wondered. Jess Knutzen, farmer with dirt on his shoes, and a supervisor of the Skagit County Soil Conservation District near Burlington, Wash., stood looking out over the valley. His 240 acres of almost level land was beginning to feel the warmth of spring.

It was May 1958, and he was talking to Tony Harms, conservationist of the Soil Conservation Service. "Yes, Tony, I surely wonder sometimes how they are really working. I think that straw around the tile is good, but I don't know. One thing for sure, I have a lot better drainage here than in 1945."

Knutzen knew the fruits of good planning and making solid investments in the land. Year after year, beginning in 1946, he had installed thousands of feet of 6-inch tile. A ditch 3,900 feet long through the middle of the farm provided a good outlet. He had carefully maintained it through the years.

Following the customs in this delta of the Skagit River, Knutzen had consistently used straw around and over his tile lines before backfilling with the rich loam soil. This was Snohomish silt loam soil, and it was good. When well-drained, it was second to none. Jess would tell anyone that he would not sell his land for any price—this was life as he knew it.

Almost since the beginning of the Skagit County district many farmers had year after year been installing tile lines. SCS engineer Maynard Parker had prepared location maps where the assistance to farmers was part of their conservation farm plan with the district. Occasionally, tile lines had been opened to check for silting, or lack of it. It seemed that no overall evaluation had been made by systematically opening many tiles that had been installed for years.

The ensuing discussion between the district supervisor and technician centered around the possibility of making many investigations of existing lines. The proposal was to check any deterioration of tile, acidity of the surrounding soil, and to investigate the condition of the straw blanket around the tile after several years' use.

Some farmers were known to have used wood

Note:—The author is a civil engineer, Soil Conservation Service, Seattle, Wash.

chippings. These were cheaper than buying baled straw. Several farmers believed chips would last longer. Either the straw or the wood is considered by farmers to have two purposes: (1) prevent fine soil particles from entering the tile joints and silting up tile lines and (2) increase ability of water to find its way from the soil into the tile. Graded gravel is desirable for this, but often is expensive and hard to move to the site of the open tile ditch.

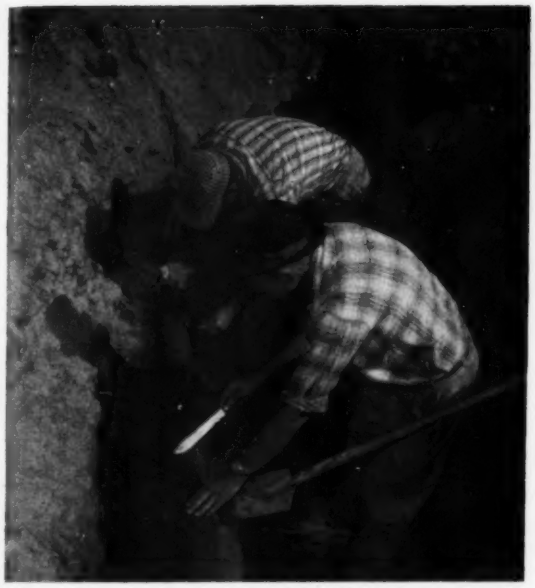
By the first of August, plans had been developed and the "look see" was set for the middle of the month. At this time the ground would be dry and no mud encountered. Six farms with different soil situations were to be investigated. Farmers were greatly interested and indicated, "Yes, I certainly will be here that day and see what seems to be going on in my tile lines."

Uncovering a tile line in many places during August is not easily and rapidly done with a shovel. The most enthusiastic worker is likely, in the hot sun, to slow down after one or two openings. Therefore, they decided to use a power machine that could be rented in the area. A large size, rubber wheeled machine with a backhoe mounted on the back was used. Able to travel at 20 miles per hour from farm to farm, this made it possible to visit the six farms in a short time.

Copies of the maps made through the years were on file in the local SCS office. These and a measuring tape were used to determine the locations and alinement of the tile. A steel prod located precisely the position and depth of the buried tile. With the backhoe operating from a position parallel with the tile, a trench was made directly over the line. The skillful operator removed all but a few inches from over the long buried tile. A secondary trench was then opened parallel to this and extended 2 or 3 feet below the tile line. During the day and a half of work only four pieces of tile were broken by the machine. Interested technicians of SCS and farmers armed with shovels, knives, and hand garden spades leaped eagerly into the trenches and scraped soil from over and around the buried lines.

Careful removal of three or four lengths of the drain tile revealed many things concerning siltation, deterioration of tile, and cover over the tile itself. The extent of remaining straw and the wood chips was easily determined. Clearly visible on the "squared up" dirt wall was the outline of the original trench dug when the tile was installed.

SCS Engineer Earl Cowley holds steel probe on tile as excavation begins.



SCS engineers prepare to open a 10-year old clay tile on the Hulbert farm.

Following the taking of soil samples and acidity tests, the removed tiles (or replacement ones) were carefully put back in place. Only a few minutes was required by the machine to backfill and tamp the removed soil.

The oldest installation investigated was a clay tile line placed in 1935. Having been in operation for 23 years, no remnants of straw were visible next to the tile. This line was functioning quite satisfactorily except near the upper end where some years before surface water rapidly entering through a crevice in the ground had caused siltation of fine material for 100 feet downslope.

Samples of siltation material in tiles, acidity of material adjacent to the tile, and pieces of deteriorating tile were taken for analysis and study. A technical report prepared by SCS indicates, among other conclusions, that:

1. Remnants of the straw as placed about the tiles have lasted 10 years. Longer life would result if more straw were used. The straw prevented infiltration of fine material into the tile.
2. A slow deterioration of concrete tile takes place where the soil is more than mildly acid —pH 6.5. Many pieces of tile were softened sufficiently that a dull jackknife would easily loosen and remove an eighth of the original tile surface.
3. Tile lines that are submerged for a long time accumulate an organic clinging scum growth around the entire inside surface of the tile. Scum an inch thick had developed in many cases. Poor outlet ditches and the low lying position next to salt water seem to be responsible for this condition.
4. Wood chips are an effective medium to encourage inflow into the lines. The chips should be coarse. Less deterioration of these chips is evident than in the straw. In some instances there was evidence that the chips had been forced away from directly over the tile during the backfilling operation. A narrower trenching machine and more generous use of the chips should correct this.

Among the interested farmers was Birger Johnson, who said, "Sure, I know the lines are full of water too much of the time. We certainly do need a drainage pump over near Edison."

Farmers plan to install the pump in 1959. This will make more effective use of the drainage tiles on Johnson's farm as well as those of his neighbors.

Silt and sand in a 6-inch tile on the Knutzen farm, 11 years after installation.

Tree Farming In Ashley County

A Soil Conservation District Supervisor Tells How His District Made Better Use of Land and Converted from an Economy of Forest Liquidation to an Economy of Tree Farming.

By BOB PUGH

THE nationwide soil conservation district program is based on a philosophy of teamwork and cooperation. The boards of supervisors of these districts call on individuals, business firms, civic groups, local industries, and numerous state and Federal agencies for assistance in getting the big job of conservation done, whether it be in woodlands, pastures, croplands, or wildlife areas.

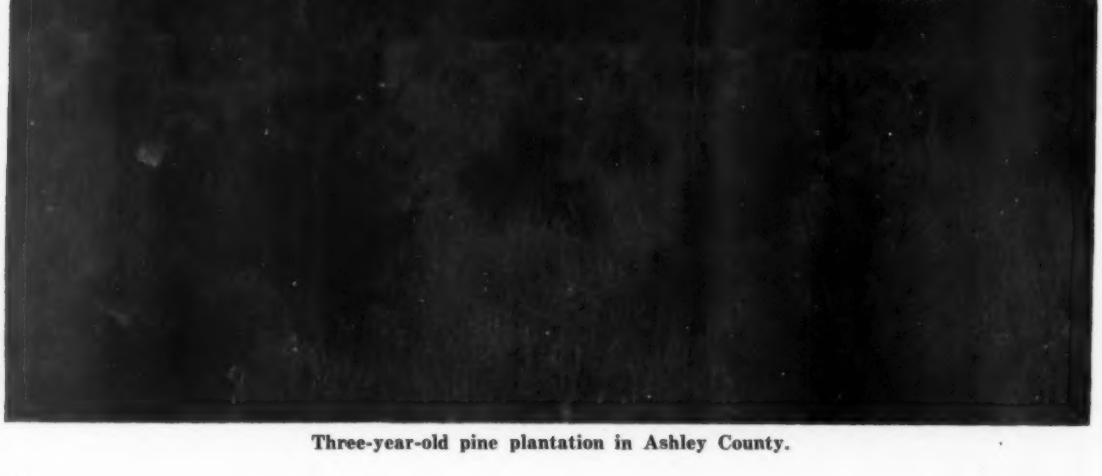
The Ashley County Soil Conservation District in southeast Arkansas is, in many respects, typical of numerous other districts throughout the country. The main emphasis has been and should be on cropland, where soil erosion is most active. However, 61 percent of the land of Ashley County is in woods. In fact, the timber industry is the life blood of the district's economy. The tree crop, and certainly trees are a crop, could not be ignored.

The small woodland owners of the district have seen first hand, over a period of 30 years, the development of the forestry program of the district's largest industry, a company that operates a sawmill, chemical plant, and pulp and papermills and has a progressive forestry program. It was supposed to have closed its doors in the 1920's for lack of timber, but is now bigger than ever as a result of its foresighted program of resource management.

Trees have become a cash crop and woodland owners have recognized this fact. They are now interested in doing something about their own woodlands.

The records of the Ashley County Soil Conservation District show the increasing interest of district cooperators in the woodland phase

Note:—The author is a farmer and chairman of the board of supervisors, Ashley County Soil Conservation District, Hamburg, Ark.



Three-year-old pine plantation in Ashley County.

of the conservation program. In 1951, when the district was organized, there was practically no tree planting in the county. In 1955, a total of 560,000 seedlings were planted on small ownerships. During these same comparative years, timber stand improvement increased from practically nothing to 690 acres; woodland thinning increased from practically nothing to 469 acres; harvest cutting from practically nothing to 2,636 acres.

The records for the first 6 months in 1956 show an even greater increase. During the first 6 months of 1956, twice as much was accomplished as in the entire year of 1955—623,000 pine seedlings planted, 1,208 acres of timber-stand improvement, 739 acres of woodland thinning, and 1,294 acres of harvest cutting.

An urgent conservation need in the Ashley County district is to return to production about 65,000 acres of abandoned farmland and other idle acres.

Trees are the answer for much of the idle land, and in 1952 the district supervisors took definite action to get the job done. The largest lumber company of the county was the logical one to approach for advice and counsel on this matter. After studying the matter, the company agreed to furnish 250,000 free pine seedlings to be distributed to small landowners. The landowners paid the cost of planting the seedlings. After seeing that a planting machine was needed, the large lumber company lent a tree planter to those landowners who wanted to use it.

Dry weather during that planting season created another problem. Tree planting was delayed and the supervisors thought that one tree planter was not enough to get the trees planted during the reduced planting season. So, determined to get the job done, they contacted 20 men in the district and told them about the problem. The result was that each of these men agreed to lend $15 to the district to be used for the purchase of another planter. This money was to be paid back from the earnings obtained by charging the landowners 50¢ per thousand seedlings for use of the machine. The planting machine was paid for in a very short time.

The tree planting program has never lacked for participants. In fact, the number planted has increased each year and now the limiting factor is the availability of tree seedlings.

Low-grade hardwoods girdled and underplanted with pines 10 by 10 feet. A few hardwoods were left as seed trees.

The district supervisors conducted a conservation tour in 1952. The purpose was to acquaint farmers and other landowners with the conservation problems in the district and to show these people some of the work that was being done through the soil conservation district program. On this tour, drainage, irrigation, pasture establishment, and woodland conservation were observed. One stop was made to see the district-owned tree planter on the Houston Chapman tree plantation. Another stop was at the Harry Allison farm to see a demonstration of the woodland phase of a conservation plan in action.

Mr. Allison explained to the group how he marked his timber for thinning, using the "D +6" spacing guide. He also showed where he harvested crop trees to create openings for reproduction and girdled weed trees to release desirable species. Mr. Allison owns 120 acres of woodland and is managing it on a 5-year cutting cycle. His land is divided into 5 fields of approximately 24 acres each. Annual income is provided by cutting one field each year.

At present, more than 100 farmers are carrying out woodland conservation practices in cooperation with the district. Tours such as this proved helpful in creating interest in the conservation program.

Planting pine seedlings with a tree-planting machine in Ashley County.

Sound technical guidance from competent and experienced technicians is a necessary part of the soil conservation district program. The district supervisors are responsible for securing this technical assistance from either private or public groups. One of the principal sources of such help is the Soil Conservation Service which is responsible for helping farmers develop complete farm or ranch conservation plans that include the safe and most profitable use of all their land.

In helping the farmer or rancher develop his conservation plan, SCS technicians use land capability information to point out the best use of each piece of land including that suited for woodland. They show landowners that there are many things they can do to improve their woods and tell them where they can get technical help on the more complex jobs from consulting foresters, the state forestry agency, and industry foresters. Once interest in woodland is developed and the landowner recognizes the moneymaking possibilities of trees, he may get further help from a number of sources.

The Ashley County district gets much of its technical assistance in the management of the small woodlots from the large lumber company of the county. Company foresters are available to advise the owners on the proper management of their woodlots. When marking is needed, trained technicians will do the marking with no obligation to the landowner.

The forest products industry realizes its opportunity to assist small landowners to grow bigger and better wood crops. The pulp and paper industry has been especially active in providing technical forestry assistance. This industrial association and most of its members employ conservation foresters who devote all of their time to this work. In Ashley County such assistance has been available from an international paper company as well as the large lumber company of the county.

Much has been accomplished over the past 25 years in American forestry in converting from the old economy of forest liquidation to the new economy of tree farming. We all have a definite stake in our country's timber resources. The Ashley County Soil Conservation District is proud of the progress it has made on its woodland program. Most important, it has all been made through the democratic processes of education, field trials, demonstration, and cooperation.

BUFFALO RANCH

By VELMA NIEBERDING

ONE of the big attractions for tourists on Highway 66, north of Afton, Okla., is Russell Kay's "Buffalo Ranch." Travelers and local residents never seem to tire of watching the huge, shaggy animals grazing in neatly fenced pens adjacent to the buildings that house the attractions of the tourist center.

Mr. Kay has 180 acres of pasture where his buffaloes roam when they are not being photographed or admired by visitors at the ranch. Recently, in cooperation with the Ottawa County Soil Conservation District, he began a "conversion" program to transfer his land once used for farming, into a suitable feeding range for the buffalo. A small herd of Texas longhorns and a few "cattalo" (half–buffalo and half-cattle) will share the new grazing range.

"We chose bermudagrass as the ideal grass to reestablish the pastures that had been under cultivation," Kay explained, "because it is fast-

Note:—The author is a feature writer, Miami, Okla.

Pasture sodding with bermudagrass on Buffalo Ranch.

growing and will withstand the rough treatment the buffalo will give it."

Commenting on the "cattalo" Kay said that while these hybrids of the animal world were said to inherit superior qualities from both parents, they have not proved practical for commercial breeding. But as tourist attractions they are superb.

In the early days of Oklahoma, the buffalo grazed on bluestem, grama, and other native grasses; when he wanted a delicacy he browsed on shrubs and bark. But today's American Bison, completely assimilated into a "white culture" civilization and protected by conservation laws, must now depend on conservation programs to keep him supplied with nutritious and plentiful pasture.

A large buffalo bull may reach 11 feet in length and stand 6 feet at the shoulder. The reddish-yellow colored calves look more like Guernsey cattle than buffalo. However, as the animal grows older the color changes to a more uniform and darker color, particularly in the female.

Buffalo grazing bermudagrass on Russell Kay's ranch near Afton, Okla.

Kay emphasized that the "buffalo burgers," which are a speciality of the ranch kitchen, are not made from any animals seen grazing about the premises.

"We import all of the meat," he said, adding that the buffalo burgers are a popular item on the menu.

So the buffalo on the Kay acres, gentled by domesticity, yet fierce enough to repel too-enthusiastic camera addicts, spends his days in protection without any of the problems faced by his ancestors of the western plains.

It is only when the huge animals lift their muzzles to scent the spring breezes, or peer with near-sighted wicked little eyes across the prairie that the visitor to the ranch feels a little sad. Despite the lush bermuda, one imagines the buffalo would rather be roaming than restrained; that he would prefer a buffalo wallow to insecticide sprays; that he listens nostalgically for the thunder of buffalo feet that will never come.

EARLY EXPLOITATION.—"We ruin the lands that are already cleared and either cut down more wood, if we have it, or emigrate into the western country—yet such is the force of habit that we cannot depart from it."

GEORGE WASHINGTON

GOPHER GETTERS

By CHARLES G. VAN GORDER

THE Camp Verde and Verde-Oak Creek Soil Conservation Districts, in central Arizona, sponsored a "Get-Out-The-Gopher" contest to arouse more interest in the control of pocket gophers on irrigated farmlands.

Gophers tunnel in the ground and eat the roots and crowns of plants. They damage many crops such as alfalfa, vegetables, and fruit trees. Even greater damage results from the loss of water and soil on irrigated lands. Burrows in the banks of ditches and canals may lead to breaks in the earthwork through which water is lost and adjacent lands are flooded, making expensive repairs necessary.

When an irrigated field lies adjacent to a cut bank, arroyo, or riverbank there is always danger from the presence of gophers. Water escaping to a lower level through a gopher hole may cause serious damage. Besides wasting water, it can result in the formation of a big gully and loss of part of the field.

Working together as a team, the two soil conservation districts, the University of Arizona, the Extension Service, the Fish and Wildlife Service, the Soil Conservation Service, and the public schools have shown what can be accomplished by cooperation in a very worthwhile project in the Verde Valley.

The contest was a huge success in many ways. By actual count, 1,485 gopher tails were turned in by 19 boys and girls who competed in the 2-month long contest.

Note:—The author is work unit conservationist, Soil Conservation Service, Cottonwood, Ariz.

County Agents Alvin Allen points to a hole in a crumbling bank caused by a pocket gopher, while Frank Gyberg, SCD supervisor holds the trapped gopher that caused the damage.

Champion gopher-getter Nancy Bates, who contributed 232 of the 1,485 gopher tails on the table in front of her.

To start things off a planning meeting was held in the fall of 1958 at Camp Verde to explore ways of arousing more interest and action in controlling gophers. Attending this meeting were several key farmers and ranchers, soil conservation district supervisors, the county agent, and representatives of the Fish and Wildlife Service and the Soil Conservation Service.

After discussing how to get people interested in doing something about gopher control the idea of a contest seemed to be the logical answer. The Yavapai County Agent Alvin Allen helped organize and conduct the contest.

The two soil conservation districts agreed to put up the prize money of $100 to be given as follows: $25 as first prize, $15 as second prize, and $10 as third prize. Then in order to encourage more boys and girls to enter the contest the district supervisors set up 10 prizes of $5 each. And at the termination of the contest they added six more prizes of $2.50 each so

every boy and girl who participated in the contest would receive a prize.

The biggest task was that of informing all school children about the contest. This job was done by the county agent and Walter Walker of the Fish and Wildlife Service. Short programs were held at the Cornville, Camp Verde, and Cottonwood Elementary Schools and at Mingus Union High School in Clarkdale.

Then in order to arouse still more interest these men met with the various civic clubs in Camp Verde, Clarkdale, and Cottonwood communities. The local newspaper, *The Verde Independent,* carried numerous spot stories about the contest from time to time during the 2-month period. The radio station KCLS, which covers the valley, announced the leading gopher catcher each week. During this time two field-day demonstrations were held to acquaint the public on how to trap gophers.

In order to be eligible for a prize each boy or girl contestant had to turn in a minimum of 10 gopher tails to the school custodian, who kept the official count.

Champion gopher-getter was 9 year old Nancy Bates of Cottonwood, who trapped 232 and won first prize money. Close behind was Mary Davidson of Camp Verde who turned in 226 tails. Third prize was won by Bernard Edge of Camp Verde with 190 tails to his credit.

One Saturday morning early in February the winners were presented their awards by Chairman Ben Wilson of the Camp Verde Soil Conservation District.

When one considers the destructive damage gophers cause to fields, irrigation ditches, fruit trees, gardens, and crops it is terrific. The trapping of nearly 1,500 gophers has destroyed a potential several thousand other gophers. Trapping 20 to 25 gophers per acre is not uncommon in the Verde Valley. It is a job that must be carried out all the time because the gophers migrate to and from adjacent areas.

Gopher control work is an important soil and water conservation job on farms, ranches, and small acreages. A real conservationist must keep the gophers under control at all times.

This contest was so successful that the boys and girls want to have another one real soon. The idea is even catching on in other soil conservation districts. This project may become an annual affair in the Verde Valley.

REVIEWS

GROUND WATER HYDROLOGY By David Keith Todd. 336 pp. Illus. 1959. New York: John Wiley & Sons, Inc. $10.75.

IN the "Preface" the author states that his purpose in writing the book is to present the fundamentals of ground water hydrology in a manner understandable to those most concerned with such knowledge. The book fills a much needed requirement in this respect. The author further states that the book is written primarily for use of civil engineers, geologists, and agricultural and irrigation engineers. Consequently, complete understanding of the fundamentals as presented in the book, requires a background in calculus and elementary geology.

The author has presented a minimum of original data, drawing profusely from published works. A list of references at the end of each chapter itemizes the more important literature related to the subject matter of the chapted.

The subject matter of the book is well organized. It contains 14 chapters dealing with fundamentals of ground water occurrence, movement and hydraulics; development of deep and shallow water wells; ground water quality and fluctuations; basin-wide ground water development; surface and subsurface investigations; methods of artificial recharge; salt water intrusion in coastal areas; legal aspects of ground water; model studies; and numerical analysis of ground water. The book contains many useful graphs, tables, and illustrations.

The book, in general, summarizes and brings up to date, basic information related to the subject of ground water and problems of development, use, and conservation. In this respect it is particularly valuable as a text book for college students, as a reference guide to ground water research specialists, and as a practical handbook for engineers and geologists.

—L. C. GOTTSCHALK

WORLD RECORD COTTON CROP.—The Foreign Agricultural Service estimates that the 1958-59 world cotton crop will be about 44.7 million bales, the highest on record. The previous record crop was about 43.5 million bales, in 1955-56.

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DISTRICT PROFILE

H. W. GARRETT of VIRGINIA

"CONSERVATION has become a part of me," said Mr. H. W. Garrett, who has been active in soil and water conservation for almost 20 years. Mr. Garrett became a supervisor in the Northern Neck district in 1940. He has continued on the board since then, and is its chairman at present.

"Shorty," as he is better known, was born at Green Bay, Va. and was reared on a tobacco farm. He attended Hampden-Sydney College and was graduated with a B. A. degree in 3 years. He also holds an M. S. degree in Agricultural Education from Virginia Polytechnic Institute.

He moved to Northern Neck in 1937. In 1940 he became a member of the board of supervisors in the newly formed Northern Neck Soil Conservation District.

"I have always been deeply interested in the conservation of our natural resources, but was a bit surprised when elected as a director of the State Association of Soil Conservation Districts during my first year as supervisor," said Mr. Garrett. He served as chairman of the nominating committee of the State association for 15 years and was also on the legislative committee. He served as vice-chairman for 1 year in the State association, of which he is a charter member, and has attended all meetings.

Mr. Garrett taught vocational agriculture from 1919 until 1957. Besides this and conservation work, he has been active in many other organizations. He was charter member and first chairman of the Mathews County Ruritan Club. He also helped organize the Northumberland County Ruritan Club after moving to the Northern Neck and served as first chairman.

H. W. Garrett

He is past governor of the Chesapeake District of Ruritan National. He also served as chairman of the county Red Cross, War Fund drive, and bond sales. He is a member of the Virginia Academy of Science.

Mr. Garrett is married to the former Anne Marion Webb, of Richmond, Va. They have one son, H. W., Jr., and one granddaughter.

—W. A. PHILLIPS